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ISOLATION OR COOPERATION IN RESEARCH[1]

THE phrase cooperation and coordination has become a familiar slogan in a number of fields of human activity. It is the slogan of an organization of scientific men with which I am connected. But not all scientific men accept it as a desirable slogan. Some scientific men think cooperation and coordination in science not only not desirable things to promote, but positively undesirable things to attempt to bring about. Part of this difference of opinion exists because there is no unanimity of understanding of what is meant by cooperation and coordination. But part of it exists because there is an honest disagreement as to the relative value of scientific men working as isolated individuals or as groups of individuals with a more or less well-defined program of work to be achieved.

Cooperation and coordination imply a certain degree of organization, and this word also brings its uncomfortable reactions. While scientific men will agree that organization is a good thing in business and industry, in factory production and in marketing, in carrying on war and managing a fleet, some of them do not at all like the word organization used in connection with science. They say that organization is out of place in science. They say that science, like music and art, ought not to be, and can not successfully be, organized. They ask if Copernicus, Galileo, Faraday, Darwin and Einstein could have been "organized." I am sure the answer is that they could not. Which is not at all to say, however, that much scientific work can not be advantageously organized, nor many scientific workers much aided by cooperating and coordinating measures. Even the Darwins can be helped by organized measures to remove material obstacles from their path; measures to relieve them of all distracting and wasteful exertions so that all their time and energy can be concentrated on their great adventures.

There are about six thousand professional working biologists in this country. But how many are Darwins? There are about seven hundred fellows and members of this society, but how many Hagens, Harrises, Walshs and Fitchs are there among us? That is to ask, how many of us scientific men are

[1] Annual public address before the Entomological Society of America, December 30, 1925, Kansas City, Missouri.

geniuses; almost all geniuses are absolute individualists, not cooperators and certainly not subject to coordinating organization. There are some extreme individualists, too, who are not geniuses. Their temperament and abilities are such that they can not work in team. These, too, are not to be organized.

But most of us are not geniuses. We are not likely to make an epochal discovery nor to produce an epoch-making idea. We are able, however, to do a lot of sound, useful, scientific work both in fundamental science and in its applications. We are just capable, industrious, well-trained workers with more or less pronounced gregarious instincts, socially minded, able and willing to play and work together. Our gregarious instincts reveal themselves in the establishing and occasional meeting of such societies as this one that is meeting to-night.

But these societies do not get formed simply because of our liking to come together socially. There is always in connection with them a conviction that by this association we may be and really are enabled to promote and achieve some undertaking of common interest and worth to all of us. We most of us believe at least in *this* form of cooperation in science.

For example, there has been organized comparatively recently a Union of American Biological Societies, resulting in a federation of about fifteen societies variously primarily interested in zoology, botany, physiology, ecology, and so on. The union is a federation, not an amalgamation, of the societies, and each one retains its individual integrity.

Now the especial reason-of-being of this federating action was that a certain important need common to all biologists had grown more and more obvious and there seemed to offer an opportunity, needing only firm seizing and strong backing, to get this need met. The strong backing required was a united pressure from all biologists of the country, which could best be exercised by setting up a federation of all the important biological societies. As a result of the endeavors of the union, strongly supported by the National Research Council, a subvention of $350,000, to be expended over a period of ten years, has been obtained from the Rockefeller Foundation, which makes possible the establishment and maintenance of a much-needed comprehensive journal of biological abstracts. The editors of this journal, already at work, expect to be able to produce and publish abstracts of every important biological article published in every important periodical in the world which publishes biological papers.

The union having accomplished this by cooperative endeavor—not only by virtue of cooperation among its member societies but by virtue of cooperation with another major scientific organization—is now in the way of making further efforts to help meet another prime need of the working biologists of the country, namely, the need for increased opportunities for the satisfactory publication of original papers. This will require still larger financial support than that necessary for the preparation and publication of biological abstracts, but the great philanthropic foundations are inclined to count the need more than the amount of money involved. They are inclined to be generous to those who can show a real need, and especially are they inclined to be generous to more or less well-organized groups of men ready to attempt to achieve a common goal by united effort.

But the formation or existence of scientific societies do not bring up the real moot point suggested by the phrase "cooperation in science." The setting up of societies made up of cooperating individuals and of unions made up of cooperating societies excites no special debate. Their utility and desirability are rather taken for granted. Experience has demonstrated to all of us their advantage. What *does* invite discussion is the bringing together of a group of scientific men to undertake investigation in conformity with a coordinated plan. This involves the statement of a major problem needing solution, its analysis into specific parts and an organized distribution, by mutual agreement, of these parts to individual workers, or small groups of workers, whose work, when accomplished, shall all be brought together and made known for the general benefit that this contribution to scientific knowledge may effect. This kind of cooperation and coordination, or in one word, organization, in science, is what excites a certain criticism—fortunately ever growing less in sharpness and amount.

This criticism proceeds, I think, not from any conviction, growing out of the observation of the scientific work accomplished in this cooperative manner, either of faulty work or harm to the workers, but from a rather widely accepted assumption that most of the great advances in scientific knowledge and theory have come from men working alone. It is true that most of the epoch-making events in the history of scientific advance are associated with the names of single individuals. But I have certain observations to make in connection with this matter.

First, I wish to suggest that a careful examination of the history of these epochal events will reveal that in most cases the coming about of these events has not been due alone to the individuals whose names are so familiar in connection with them, but to a rather sudden crystallization around them of a solution to which many men and minds have made their separate contributions. Of course, this crystallization has often come about at the particular time and place at which it did because of the

superior understanding, by the final contributor, of the significance of the many facts gradually made known from many sources. And because of this superior capacity for seeing significance and for generalizing, the so-called discoverer should have the special credit so widely conceded to him. It is undoubtedly true that many an important advance in science has had to wait for its realization for the coming of the special individual whose personal contributions have been so invaluable. But how much work of how many other men, lesser men, we may call them, have gone to making possible the culminating discovery? And how much could this special individual have been helped, and the discovery often been speeded up, if he had had the planned cooperative assistance of other workers, to save him time and energy?

And this brings me to my second observation regarding the dependence of the epoch-making event on the individual. The individual in this case is usually a genius. His is a super-brain driven to continuous work and cogitation by an innate force that needs little extraneous encouragement or aid. And his brain works constructively; it sees significance; it puts facts together; it generalizes. But the genius is a rare bird. If we look back over the history of science we are able to count a respectable total number of scientific geniuses. But this history covers many hundred years. How many scientific geniuses can you list of any single century? How many exist at any one time? How many exist today? I have already asked that question earlier in this discussion and suggested the answer. You will all agree with that answer.

But does the advance of entomological science depend solely on entomological geniuses? Are we who are deeply interested in this advance and ready to do our little part to help it along, to sit idle while we wait for the rare bird to wing his way over the horizon? Let us not be too modest. The seven hundred of us enrolled in this society mean something for entomology. Let us mean as much as we can. We can all do something, and we can do more if we help each other, if we plan together and work together along lines and by methods which recommend themselves by united counsel.

Herbert Hoover, in a recent important address before a body of master engineers in which he made a stirring plea for the advancement of fundamental scientific research in this country said: "The time is gone by when we can depend very much upon consequential discovery or invention being made by the genius in the garret. A host of men, great equipment, long patient scientific experiment to build up the structure of knowledge, not stone by stone, but grain by grain, are to-day the fundamental source of invention and discovery." But Mr. Hoover does not want the genius to be overlooked. He wants him to be helped with equipment, assistants and time to the fullest extent needed or desired by him. There is needed a certain organization of our scientific resources even to do this. But Mr. Hoover urges us not to depend on the genius alone. Let the lesser men, lesser as compared with the geniuses, but men intelligent, well-trained, industrious, devoted and eager—and that means most of us—do their best. Let them help each other by willing cooperation; let them put their heads together and plan and coordinate and organize their attacks on major problems, so that time and energy will be saved by avoidance of repetition, overlapping, undirected effort; in a word, by avoidance of physical and intellectual waste. Let us work individually at special parts of a major problem—but collectively in our attack on the whole problem.

Here is a little example chosen from among the various projects taken up by the Research Council. At the suggestion of some men especially interested in the problem of the biological relations of insects to flowers there was appointed, by the council's division of biology, a special committee under the chairmanship of Dr. Frank E. Lutz, of the American Museum of Natural History, to plan and carry through some coordinated work on insect visits to flowers with particular attention to the distinction between "ultra-violet flowers" and others.

As you all know, of course, much work has been done on the relation of flower colors and patterns to insect visits, but little of this work has taken into account the possible large importance of a possible recognition by insects of colors, if one may so call them, lying outside the solar spectrum visible to us.

The work as planned required the cooperation of entomologists, botanists and physicists. To support the work, that is, provide workers and the small funds needed, the council, the American Museum of Natural History, Cornell University and the University of Colorado, joined hands, and an admirable piece of work, or group of related pieces of work, was accomplished, as those of you who have seen the various published papers, giving the results of the undertaking, will bear witness.

I have chosen to refer to this comparatively small cooperative project rather than to one of the larger and more expensive ones which the council has set up because it touches a problem of special interest to entomologists. But it is an example of many others. There are, too, of course, numerous coordinated cooperative projects of research instituted by other agencies than the council. The Carnegie Institution's elaborate and important present seismological investigation is such a project. Various gov-

ernment scientific bureaus undertake such cooperative projects. I only refrain from referring specifically to others because I do not wish to take too much of your time, and because other examples must be already familiar to most of you.

Let us not be afraid of organization. It means no real surrender of individual freedom or achievement. It only means that we direct our efforts more intelligently, to more important undertakings, with more material aid and more mutual encouragement. Organization lies in the very spirit of America. See what great things it has accomplished in American industry. Can American science not profit also from it? No one wants to organize the geniuses; no one proposes to; no one can. But I am no genius and most of you are no geniuses. Yet you and I counselling together, planning together, working together, can do something steadily to advance scientific knowledge. And that some geniuses at least do not scorn association with other workers nor hesitate to recognize the advantage that coordinated work may bring to science, is proved by the fact that in some of the most pronounced attempts in this country to set up coordinating enterprises a number of the men to whom American science owes most and of whom we are all most proud, and whom we recognize as geniuses if we recognize any at all, are taking an enthusiastic part.

Dr. Henry Pritchett has said:

> The world still conceives of scientific investigators in much the same light as the old-time prospectors for the precious metals—each individual sinking his shaft here or there as chance or inclination may carry him. Of the great number so engaged a very few will strike veins of true gold, a larger number will obtain ore that will at least repay the labor and cost involved in their adventure, but the great majority will sink holes in barren and fruitless soil.
>
> The prosecution of research to-day [he continues] is upon an entirely different basis. Not only do those in the same science coordinate their work, if they are to attain the highest results, but all branches of science are regarded not as separate and unrelated agencies, but as parts of a common effort. A research started in a purely physical field may find its solution in a chemical reaction or a physiological process. The research men of a nation are not isolated individuals but an organized and cooperating army.

And Elihu Root, not a scientist but a very wise man, looking in at us from outside has said:

> Science, like charity, should begin at home, but has done so very imperfectly. Science has been arranging, classifying, methodizing, simplifying everything except itself. It has made possible the tremendous modern development of the power of organization which has so multiplied the effective power of human effort as to make the differences from the past seem to be of kind rather than of degree. But it has organized itself very imperfectly.

The scientific body to whose upbuilding I am at present giving all my attention and effort wants to promote in every way possible to it the sound development and increase of scientific research in this country. It wants to avoid interfering in any way with what is already going forward in this direction; least of all things it wants to dictate to any scientific man or men the things he should do. There is fortunately no possibility of the National Research Council, or any other body, ever being able to dictate to scientific men; scientific men will suffer no dictation. But it wants to help, in making things easier for scientific workers from geniuses down; it wants to influence colleges and universities to recognize ever more clearly their research responsibilities; it wants to make clear to the great industries how inescapably their success depends on scientific advance and hence that they should in every way encourage such advance; it wants to bring the support of the great philanthropic foundations, with their large financial resources, to scientific men and undertakings. And it believes in cooperation and coordination of effort. It is not afraid of that bugaboo phrase "organization in science," which is still anathema to a few scientific men.

It believes that science should not be broken up into water-tight compartments, nor men of science separated from each other by artificial barriers. It believes that entomologists should mix with and learn from general zoologists and botanists and physicists and chemists—and that these should learn from entomologists. It likes to support projects of investigation which involve the working together, in concerted ways, of biologists and geologists and chemists, of mathematicians, physicists and astronomers. It believes in bringing scientific men together for counsel. It believes there is strength and speed in union, and weakness and lag in isolation. The genius individualist it applauds and would like to help if help is possible and desired. To the rest of us who are not geniuses it wants to bring its slogan of cooperation and coordination as indicating modern methods of effective work.

VERNON KELLOGG

NATIONAL RESEARCH COUNCIL

THE SCOPE OF BIBLIOGRAPHIES

APART from the activity of a genius, three things are chiefly necessary for realizing profitable scientific work: First, clear, precise formulation of the problems; second, sharp observations in field, laboratory

or museum, and third, the knowledge of what others have already done on a subject. This last is the special domain of bibliography.

For this end published papers are registered and the references arranged by groups (in zoology, for instance, by phyla, and taxonomic categories in general, as well as from morphological, physiological and geographical standpoints). At an early period book catalogues were fairly adequate for this purpose. But when the number of publications steadily increased, this method alone could not suffice. Another form has been introduced which has proved itself more and more advantageous for the study of private workers as well as for the catalogue of large libraries—that is the card-catalogue, the mention of titles on cards which are provided with classification numbers and can be filed consecutively as issued.

This method makes it possible, even after many years, to find all cards on a special subject together in a relatively small place.

This matter has now entered a new phase, in so far as the number of published papers has grown so large that the cost of such a card catalogue is beyond the *present* means of many institutes. The budgets of the institutes for expenses on bibliography are still adapted to the old requirements. In fact, while bibliography has quantitatively reached an absolutely new level, the budgets of the institutes as well as most naturalists continue to estimate the necessary expenditure on bibliography on the former scale.

It is therefore necessary to examine more closely the essentials of bibliography, and this can be best done in a country where, as, for instance, in the United States of America, the elaboration of bibliographical services has recently been particularly advanced, thanks to the special interest of the Rockefeller Foundation.

Such an analysis of what bibliography is demands a study of both practical and intellectual factors, and consequently it is perhaps no mere chance that a special interest for this study is shown in countries with a practical mentality: in the United States of America and Switzerland, where the first scientific bibliographer had worked, the naturalist Conrad Gessner, as was emphasized, for instance, by Mr. J. Christian Bay, of the John Crerar Library (in the Papers of the Bibliographical Society of America, Vol. 10, 1916), on the occasion of the four hundredth anniversary of Gessner's birthday.

What importance the knowledge of the bibliographic methods has reached is best shown by the fact that, as everybody knows, a scientific man who to-day is fully conversant with the literature of his branch of science is, from another point of view, just as powerful as a skilled technical worker in the experimental field. And this is not a transitory or unmotivated situation. It is brought about by the fact that, as has been stated above, one of the roots of scientific work is the formulation of questions, and it is just by the knowledge and critical use of bibliographies that an essential advancement is achieved in the manner of raising questions. For this reason not only must technical training be provided in the universities but also the use of bibliographic methods must be taught, as has been already realized in an initial form through the efforts of Mr. Andrew Keogh, librarian of Yale University.

The claims which are made on bibliography are as different as the special domains in which work is done. For instance, in zoology, *taxonomists* want a survey, which shall be quick and as complete as possible, of all new species that have been described in their domain, whether the reference appeared in one of the principal American publications or in a local paper in Switzerland, Mexico or Borneo. Practically, in this case, there is, however, even more to be expected of the personal contact of these specialists than through bibliography.

It is evident that existing bibliographies can also be of use for such a purpose. In fact, book-bibliographies will render services in proportion to the extent of the material which their funds permit them to collect, but without offering the advantages of a card catalogue. As regards card bibliographies, of which—also in this case of taxonomists' requirements—Mr. Gordon Gates (SCIENCE, Vol. 62, No. 1592, July 3, 1925) seems to expect the same services, they are in an essentially different situation, as will be shown in the following sections of the present article.

Of course the *experimental worker* or the *embryologist* likewise wants to know as soon as possible what has been done in his domain. But his dependence on the promptness of information is of a less degree than that of the taxonomist, because he will much more often be allowed to uphold the results he has found independently of the most recent discoveries.

Quite different is the claim to bibliography of the *general zoologist,* who has to survey a large part of this science. He will often be face to face with new problems to which he has not devoted his attention before, in view of the great surprises which the advancement of science involves. This will also be the case for the *general biologist* who, while experimenting on heredity, sees himself compelled to be oriented, *e.g.,* on the varieties of the butterflies of Japan. Here it will be a great advantage for him to be able to find immediately and easily in a card catalogue a number of titles on this new subject. From this starting point he can step by step attain further information.

And here, besides the claim to promptness and completeness, another function of bibliography comes to the fore, which is a very essential quality of bibliography, though not as popular as the other two. I mean the character of bibliography as an anticipatory and reserve instrument, which allows one to confront problems arising from such unexpected situations. This last purpose is accomplished in a remarkable and unique way by a card catalogue which extends over some decades, such as the complete zoological card catalogue of the Concilium Bibliographicum.

In the same way as many melodies can be called forth from a musical instrument, an infinity of kinds of information will be found in a card catalogue, provided its use is understood. Of course this demands a certain degree of training. Without such a training only the most superficial advantages will be obtained from any catalogue. Just as the other two roots of scientific work, precise formulation of questions and technical work in the laboratory, can not be perfected without training, this is also the case for the third component of scientific work, the consideration by means of bibliography of what others have achieved.

It is absolutely necessary to work with the same carefulness in the library as in the laboratory. Only thus is good work produced, that is to say, useful and lasting work. If no care is given to the literary elaboration of one's own papers and no consideration is shown for the work of others, a *circulus vitiosus* is originated. Professor Sedgwick Minot, in his excellent vice-presidential address delivered before the section of physiology and experimental medicine of the American Association for the Advancement of Science, 1911, has already said:

> If an author fails to show respect for his own scientific work, how can he expect others to respect it.

And in partly reproducing Professor Minot's address in the "Annotationes Concilii Bibliographici" Vol. 7, p. 1, Dr. Field, the founder of the Concilium Bibliographicum, added the following instructive observations:

> It is amazing with what callous neglect authors cast these children of their intellect into the great world in the fatuous belief that they have provided for the future of their offspring, that they have made a "contribution" to science. It would be interesting to study statistically the sum the world spends to-day in printing and publishing the results of research compared with the expenditure on making these same publications accessible and of value for the progress of science. The disproportion would certainly be startling.

Since then of course bibliographic work has obtained the support of the Rockefeller Foundation and of the United States National Research Council. This support concerns the *production* of bibliographies, that is, the outward frame, which had suffered through the war; but beyond this it is necessary to meet the undervaluation which most naturalists cherish for bibliography. This can be changed only by degrees, when the scientific worker will become aware that bibliography stands in about the same relation to the original papers as interest to capital debt. Both must be kept in mind, else there would arise situations which through the disregard of the interest, respectively bibliography, might become confused and dangerous, one for economics the other for the future of science.

In such a time as the present, when so many more people do scientific work than before, it is necessary to consider in a larger measure the work of others to look out for and to understand it. But very often the contrary is observed (in some respects an anachronism), that very little trouble is taken to consider and do justice to the activities of others and to the thoughts they propagated. Partly in consequence of this, bibliography is considered as something unessential which must be disposed of quickly and easily. Apparently time is gained by this, but in reality much cooperative energy is lost through non-consideration of what others were aiming at and have found, and our responsibility towards humanity is in danger of being compromised.

Before such a line of thought is recognized, the importance of bibliography will not be acknowledged at its full value in the mentality of the individual worker, and in consequence it will not get the share due it in the budgets of the public scientific institutions. For the present in most European scientific laboratories no special item for bibliography is included in the budget. The necessary bibliographic purchases must be made out of the budget for the library. And yet bibliographical instruments, just as the collections in a museum, are most important means of teaching and documentation which certainly justify a separate appropriation of funds. That this situation is being recognized and will in time be altered, was shown, *e.g.*, by the importance accorded to the discussion of bibliographic questions during the third International Congress of Entomologists in Zurich in 1925. This importance was also made evident during the different discussions of the Committee on Intellectual Cooperation of the League of Nations, where, moreover, the question of bibliography revealed itself to be almost the only one in the field of intellectual cooperation which can be taken up in a practical manner.

Only when every scientific laboratory has special funds for bibliographic equipment, as cabinets

card and book bibliographies, will it be possible to complete more and more the card bibliography, the value of which has been explained above, without having to meet difficulties concernnig the solvency of the subscribers. Such a time will come, and it will then be a great advantage for zoologists and general biologists to find a card catalogue ready for them, going back over thirty and forty years, as is that of an institution which the British scholar Stephen Gaselee in his "Petronius Bibliography" (Transactions of the Bibliographical Society of London, 1909) called "the zoologist's wonderful Concilium Bibliographicum," regretting that they had no such institution in letters.

In the meantime the value of an institution like the Concilium Bibliographicum consists in the consideration of the above-mentioned anticipatory and preventive functions of bibliography and in the maintenance of a continuity which in this domain is of more value than in any other.

J. STROHL,
Director of the Concilium Bibliographicum
ZURICH, DECEMBER, 1925

CARLOS WERCKLE

COSTA RICA has been favored by nature beyond all other parts of Central America, and she has been fortunate also in the development of her resources. Secluded in her upland valleys, which are fertile and temperate, and possess a climate almost ideal for human existence, she is barred on the north from the rest of Central America by high mountains and uninhabited lowlands, and from Panama on the south by a still higher chain of mountains, and by almost impassable forests. Secure in her economic position, Costa Rica has been little affected by the occasional turbulence of outside politics, and has been able to develop in peace and independence.

As one result of this happy state of affairs, more attention has been devoted to education in Costa Rica than elsewhere in Central America. Here there have lived and still live men of eminent scientific achievement, who have made signal progress in the study of the natural features of Central America. It would be erroneous to infer that there has been no progress in other Central American republics; but Costa Rica, as her neighbors are the first to acknowledge, has made greater contributions to science than any of her sister states.

In large part this advance is the result of the residence in Costa Rica, for long or short periods, of foreigners with scientific interests. Among these may be mentioned such men as Frantzius and Polakowsky, of the middle of the nineteenth century and later, and the famous Danish botanist, Oersted. At the end of the same century definite plans were adopted for improving the public school system of Costa Rica, and several Europeans, chiefly Swiss and French, were employed by the government, and resided in the country, some of them for many years. Chief of these, from a botanical standpoint, were Henry Pittier, who published numerous papers dealing with Costa Rican botany, Pablo Biolley and Adolfo Tonduz. The last collected more specimens of plants than any collector who has worked in Costa Rica and to his labors are due in very large part our actual knowledge of Costa Rican botany.

The Costa Rican government believed that with the encouragement gained by employing European teachers and scientists it would be possible to stimulate in its citizens an interest in pedagogical and scientific matters, an assumption that has been fully realized. The country has developed a superior system of public schools, and there have been educated a considerable number of men who have made their mark in the scientific world. Among those of the present generation who are interested in botanical as well as in other branches of natural history may be named Anastasio Alfaro, Alberto Brenes, Rubén Torres Rojas, Otón Jiménez and Juvenal Valerio, all of whom have performed excellent work in the botanical field and have tried to instil in others an interest in natural history. It may now be expected confidently that in Costa Rica natural science will become self-perpetuating, a condition highly to be desired for all the Central American countries.

One of the men of European birth whose name will ever be associated with Costa Rican plants was Carlos Wercklé. Born at Wiebersweiler (Vivverville), Arrondissement de Chateau-Salins (Department Meurthe), Lorraine, in 1860, he emigrated to Costa Rica about 1890. Regarding his personal affairs he was always extremely reticent, and no information is available concerning his early life. He was very proud of the fact that he was a German subject, and during the late war is said to have stated always that he was a German. This attitude will be appreciated by those familiar with conditions in Central America during and after the war, when there were no Germans to be found, but only Swiss, Alsatians or Dutch.

There is no doubt that Wercklé received a good education, and he was evidently a man of exceptional native talent. He spoke English with great perfection and fluency, likewise Spanish, French and German, and he is said to have read Latin, Greek and Hebrew with ease. His skill as a cartographer was utilized by the Costa Rican government upon more than one occasion.

Wercklé arrived in Costa Rica in company with a sister, and went to Cartago, where he engaged in the growing of flowers and vegetables. One of the most delightful features of the Costa Rican towns is the great number of gardens where flowers are grown for market. About San José there must be dozens of them devoted to growing such flowers as roses, gladioli, dahlias, carnations and callas, as well as orchids and other less common sorts. It is surprising to a visitor to learn that there is a market for such large quantities of cut flowers, in even the smaller towns, and to see how lavishly they are used. Upon the occasion of the funeral of a prominent man a dozen or score of carriages will be filled with wreaths and other formal pieces.

Many of these gardens are conducted by foreigners, and it was such a *jardinería* that Wercklé established. Later he moved to the capital, where he remained for most of his residence in Costa Rica.

He visited many parts of Costa Rica in study of the native flora, for he seems to have had a deep natural love for plants. He explored the most remote mountains for rare species, and carried in his head a wealth of intimate and curious detail regarding them. Orchids were perhaps his favorites, and at the home of Dona Amparo Zeledón, in San José, he brought together a rich collection of them, from which many new species were described.

As a collector of herbarium specimens Wercklé did not distinguish himself, although it is true that a good many specimens of his collecting are found in herbaria. His favorite way of preserving an interesting plant was to roll it into a bundle and stuff it in a pocket, where it remained indefinitely. It is thus only too easy sometimes to recognize in the herbarium his specimens, without even looking at the label. Another group that appealed to him were the Bromeliads, one of the most fascinating families of Costa Rican plants, about which we have only fragmentary knowledge. Bromeliads are well adapted to this sort of collecting, and a number of new species have been based upon Wercklé's specimens.

Horticultural subjects had perhaps the deepest appeal for him, and he took a delight in introducing into cultivation new plants and in performing experiments in their culture. Last year at El Coyolar, on the Pacific slope, where he lived for some time, I saw about the house he occupied numerous trees that he had grafted. Noteworthy, too, were some curiously grafted cactus plants that still survived, in spite of neglect.

Wercklé was not a voluminous writer upon botanical subjects, but among his articles may be found one upon the Bromeliaceae of Costa Rica (*Torreya* 1, 146, 1901), notes upon edible fungi and observations upon orchids. His most pretentious work was entitled "La Subregión Fitogeográfica Costarricense," a large octavo pamphlet of fifty-five pages, published at San José in 1909. In this he gives a vivid picture of the phytogeography of a highly interesting area of Central America, based upon first-hand knowledge. He is reported to have prepared two general works upon botany and agriculture, with special application to Costa Rica, but these manuscripts were lost and efforts to find them have been unavailing.

A correspondent has written the following concerning his other interests:

> He stated to me that his work as naturalist was of no importance in comparison with a piece of philosophical investigation that he had begun at a very early age, which would fully justify his mission upon earth. It was called "The Philosophy of the Absolute," and was written in German. But once, after a prolonged period of dissipation, he learned to his great grief that his manuscripts had been stolen from his room and sold to a *pulpería*, where they were used for wrapping soap and candles! Now that he no longer had any object for which to live, since he was too old to rewrite his work, he stated that he hoped to die as quickly as possible, and this end he sought through the agency of alcohol. A rare method of applying to himself his own philosophy!

Perhaps it was the lack of dependents that robbed him of a sense of responsibility, else it is hard to understand how a man of such natural ability and sensibilities could give himself so completely to dissipation. During the last years of his life his surrender was complete, and only a hardy constitution could have resisted so long and so well the indignities to which it was subjected. Even shortly before his death Wercklé was a man of striking appearance, strong and well built, and showing little outward effect of his indulgences. Yet at this time he had only one interest, a passion for drink. His abandon was not the result of lack of friends, for he had numbers of them, and influential ones, who did everything in their power to assist and restrain him, even resorting to forceful measures to this end; but all this availed nothing. He died suddenly on November 24, 1924.

To the northeastward of San José runs the old cart road over which freight and travelers from the Atlantic Coast passed when the Atlantic railroad had its terminus at Carrillo. The road climbs the central Cordillera by the pass of La Palma, a classic locality for plants, in a gap between the volcanoes of Barba and Irazú. Beside this highway, as it descends the Atlantic-ward slope, along the dashing stream called La Hondura, there are thickets of a

handsome tree of striking appearance. Even over on the Pacific slope there appear here and there along the road individuals of these same trees. Sometimes they stand so close to the road as almost to strike a passing rider. The trees have large round leaves and beautiful pale pink flowers, of the size and of much the same form as hollyhocks. How is it to be explained that for two generations people have been riding along this road, where practically every botanist who ever visited Costa Rica has passed, yet none of them ever noticed these showy trees? At any rate, until Wercklé, no one called attention to them, and he was the first to obtain specimens.

A few years ago this plant was described by Mr. H. Pittier and the present writer as a new genus, *Wercklea*. The La Palma species was called *Wercklea insignis*, and it is found not alone at this locality, but at other places of similar altitude. Not far away, at Las Nubes, on the slopes of Irazú, occurs a second species of the genus, discovered by Mr. C. H. Lankester and described as *Wercklea lutea* Rolfe. This latter plant is very similar in habit, a slender tree with large round leaves, the blossoms equally showy, but yellow.

Of all the many unusual plants that make the Costa Rican flora such a fascinating one, none are more notable than these two trees that compose an endemic genus. It is altogether fitting that they should commemorate the name of this erratic botanist whose explorations revealed no small number of the plants that compose the flora of Costa Rica.

PAUL C. STANDLEY
U. S. NATIONAL MUSEUM

SCIENTIFIC EVENTS

THE RUMFORD FUND

THE American Academy of Arts and Sciences received in the year 1796, from Benjamin Thomson, Count Rumford, a fund, which has since been named the Rumford Fund, in aid and recognition of researches in light and heat, branches of science to which Count Rumford had notably contributed during his eventful career.

The American Academy constituted in 1833 a standing committee of seven fellows, to supervise the trust created by Count Rumford. More than fifty scientists have served on this committee at different times since that date. The committee recommends to the academy, from time to time, the award of the Rumford premium to distinguished investigators in light and heat. It also receives and deals with applications made for grants from the income of the fund, in aid of researches in light and heat.

Since 1839, the academy has made thirty-two awards of the Rumford medal or premium. It has also made more than 260 grants of money to researchers, nearly 120 in all, in amounts varying between $25 and $750, but averaging about $260 each. These grants have been for apparatus, material or experimental equipment. They are also made towards costs of printing in the publication of researches. Only in very rare cases, however, have grants been made towards the payment of assistants in carrying on such researches.

The subjects of research that have been aided by the Rumford Fund are (1) light and (2) heat, both from the radiant and non-radiant viewpoints. More recently, the subject of X-rays have been accepted as coming within the scope of the fund.

Recipients of grants for investigations are expected to report annually to the committee, on the progress of the work in aid of which the grant was made.

Researches carried on with aid from the Rumford Fund may be published in any place or form, with the proviso that due recognition be made in the publication, of the grant from the Rumford Fund of the American Academy of Arts and Sciences. It is also expected that a complete copy of every such publication shall be presented to the academy, for its library.

Persons making application for grants from the Rumford Fund are requested to inform the committee of any similar applications, made by them, for grants from other funds, in aid of the same research or of related researches.

Applications for grants should be addressed to the chairman of the Rumford Committee, American Academy of Arts and Sciences, 28 Newbury Street, Boston. Such an application may be made by any duly qualified person in North America, or in any of the American islands. It should specify the nature of research and the particular aid desired.

A. E. KENNELLY,
Chairman of the Rumford Committee

THE NEW METALLURGICAL LABORATORIES AT THE PITTSBURGH EXPERIMENT STATION

THE new metallurgical laboratories of the Pittsburgh Experiment Station of the Bureau of Mines, Department of Commerce, were formally opened on the evening of January 26. Members of the Metallurgical Advisory Board of the Carnegie Institute of Technology and the Bureau of Mines and others prominent in the mining and metallurgical fields were present.

The new metallurgical laboratories are the outgrowth of an agreement made in 1923 under which Carnegie Institute of Technology appointed an ad-

visory board for its department of metallurgy and arranged for cooperative research fellowships in metallurgy at the Pittsburgh Experiment Station of the Bureau of Mines. Under the arrangement, certain problems in the metallurgy of iron and steel formerly conducted at the Northwest Experiment Station of the Bureau of Mines, Seattle, Wash., are being studied at Pittsburgh. In the study of these problems, the well-equipped laboratories of Carnegie Institute of Technology will be available to supplement those of the Bureau of Mines.

Among the technical problems that are being studied by the newly established metallurgical section are the melting of sponge iron; reduction and carburization in iron smelting; mill ball compositions and preparations; abnormality in case carburized steels; non-metallic inclusions of steel, and requirements for open-hearth refractories.

In the study of these problems the large technical staff of the Bureau of Mines will be assisted by members of the faculty of Carnegie Institute of Technology and by the members of the Metallurgical Advisory Board, which is composed of prominent metallurgists connected with the industrial organizations of the greater Pittsburgh district. Some of the investigations will be conducted largely in operating plants in and near Pittsburgh. Other agencies in close proximity that will help facilitate the work are the University of Pittsburgh, the Mellon Institute and the Carnegie Library.

The equipment of the new metallurgical laboratories includes a modern electric-furnace laboratory well arranged for fundamental work in many branches of the metallurgy of iron and steel; a metallographic laboratory, and a chemical laboratory.

The metallurgical section of the Pittsburgh Experiment Station is under the general supervision of D. A. Lyon, assistant director and chief metallurgist of the Bureau of Mines, and S. P. Kinney, the supervising ferrous metallurgist. The latter correlates all the ferrous work of the bureau and conducts blast-furnace investigations. The work of the metallurgical section is directly in charge of the section chief, C. E. Sims, who is also the electrometallurgist of the bureau and who handles all work pertaining to electrometallurgy or the electric furnace. F. W. Schroeder, a chemist, who has done graduate work in ceramics and extensive research work on refractories, will handle the work of the section having to do with the metallurgical requirement of refraction. B. M. Larsen, a chemical engineer, who has specialized in metallurgy, will conduct research problems in the metallurgy of steel. A. K. Hutton handles the analytical work.

THE BRITTEN BILL TO EXTEND THE USE OF THE METRIC SYSTEM IN THE UNITED STATES

A METRIC bill, for the purpose of extending the use of metric weights and measures in merchandising, was introduced into the House of Representatives on December 7 by Fred A. Britten, congressman from Illinois. The bill was referred to the committee on coinage, weights and measures, which has been holding hearings since February 1. The text of the bill follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that from and after the 1st day of January, 1935, metric weights and measures, except as herein provided, shall be used for the following purposes:

(1) For buying or selling goods, wares, or merchandise, unless permission to use other weights and measures has been granted by the United States Department of Commerce or by a state department of weights and measures or by an authorized state official.

(2) For charging or collecting for the transportation of any goods, wares, or merchandise, unless permission has been granted to do otherwise by any of the authorities designated above.

SEC. 2. Not later than the 1st day of January, 1935, all postage, excises, duties, and customs charged or collected by weight or measure by the Government of the United States of America shall be charged or collected in terms of or according to metric weights and measures.

SEC. 3. Nothing in this act shall be understood or construed as applying to—

(1) The construction or use in arts, manufacture, or industry of any specification, drawing, goods, wares, merchandise, tool, machine, or other appliance or implement designed, manufactured, constructed, or graduated in any system of measurement.

(2) The ordering, buying, or selling of manufactured articles, such as tools, machines, or parts of machines, ordinarily known by or designated in terms of any other system of weight or measure.

(3) Any contract made before the 1st day of January, 1935.

(4) The survey or description of lands within the jurisdiction of the United States of America, or transactions in lands or real estate therein.

(5) The sale of goods, wares, or merchandise originally intended for any foreign country.

SEC. 4. After the 1st day of January, 1935, the terms "world yard" for the "meter," "world quart" for the "liter," and "world pound" for "five hundred grams" shall be recommended for international use and accepted as metric terms.

SEC. 5. All acts or parts of acts inconsistent herewith are hereby repealed but only in so far as they are inconsistent herewith; otherwise they shall remain and continue in full force and effect.

SEC. 6. Rules and regulations for the enforcement of this act shall be made and promulgated by the secretary

of commerce, who shall also take such steps as he may deem necessary to make this act effective.

RESOLUTIONS ON THE FREEDOM OF TEACHING

THE following resolutions on freedom of teaching have been adopted by unanimous vote of the Sigma Xi Club of Southern California, and ordered sent to SCIENCE and the Los Angeles papers for publication:

Resolved, that the Sigma Xi Club of Southern California views with amazement and concern the propaganda that is going on in certain parts of the country, having as its object the restriction of the freedom of teaching in science.

We would remind the thinking public:

(1) that our civil, religious, intellectual and economic progress has resulted very largely from this freedom within the schools, colleges and universities of the land. To attempt to take away this constitutional right is a return to the methods of the Middle Ages.

(2) of certain essential characteristics of the method of science:

(a) a sincere search for truth without reference to the effect of such truth upon previous opinion or belief.

(b) that any statement of the findings of science is in the nature of the case a statement of the balance of evidence and not a dogmatic assertion of finality. Even the "law" of gravity is subject to revision or restatement.

(c) that there is and can be no conflict between religion and science: to assert the contrary is to misunderstand the scope of both.

We urge all representatives of science in school, college or university:

(1) to indicate a love for zealous research after truth and loyalty to truth when found.

(2) to exemplify in their own attitude both the dignity of science and the proper restraint of the workman in science. Only so can we deserve the support of enlightened public opinion.

We hereby express our hearty approval of the American Association for the Advancement of Science in its efforts to assist in reaching a prompt, clear and just understanding in regard to the rights of teachers of science.

GEOLOGICAL SCIENCES AT PASADENA

THE California Institute of Technology is organizing a staff of instruction and research in geology and paleontology. Dr. John P. Buwalda, formerly professor of geology at Yale University and the University of California, and Dr. Chester Stock, of the University of California, will be in charge of the developments in these two fields of geologic science. Instruction in geology is already being given by Dr. Buwalda.

A research laboratory of seismology has been constructed by the institute and will be equipped by the Carnegie Institution of Washington. Investigations and advanced instruction will be carried on in it under a cooperative arrangement between the two institutions.

In the developments in geology, paleontology and seismology the California Institute will place emphasis primarily on graduate study and research, as has been done in its older science departments of physics, chemistry and mathematics. Provision has also been made, however, for a four-year course of undergraduate study.

Several teaching and research fellowships, both in geology and paleontology, are offered for the year 1926–27 and thereafter.

SCIENTIFIC NOTES AND NEWS

DR. GRAHAM LUSK, professor of physiology at the Cornell University Medical College and director of the Russell Sage Institute of Pathology, was the guest on February 15 at a dinner given for him at the Waldorf-Astoria, New York City, by 130 friends to celebrate his sixtieth birthday. The speakers were William J. Schieffelin, Dr. Frederic S. Lee, Dr. Russell H. Chittenden, Dr. W. H. Howell, Dr. A. B. Macallum, Dr. Elliot P. Joslin and Dr. Lusk.

THE twenty-fifth anniversary of Professor Edward L. Thorndike's connection with Teachers College, Columbia University, was celebrated on Friday, February 19, with a dinner at which about two hundred and fifty of Professor Thorndike's colleagues, former students and friends were present. Professor Eugene L. Smith presided, and there were speeches by Dean James E. Russell, Dr. Frederick P. Keppel, Dr. J. McKeen Cattell, Professor G. D. Strayer, President Henry Suzzallo, Dr. R. S. Woodworth, President Nicholas Murray Butler and Dr. Thorndike.

DR. MICHAEL I. PUPIN was the principal speaker at the fiftieth commemoration day exercises of the Johns Hopkins University on February 22. On the same day he was the guest of honor at a luncheon given by Dr. and Mrs. Frank J. Goodnow.

AT a meeting of the Royal Society of Medicine held on January 19 the following seven medical men were elected to the honorary fellowship of the society: Dr. William James Mayo and Dr. Charles Horace Mayo, of the Mayo Clinic, Rochester; Major-General Sir David Bruce, Sir Henry Morris, a former president of the society; Dr. Fritz de Quervain, professor of surgery and director of the surgical clinic, University of Berne; Dr. Camillo Golgi, emeritus professor of histology, Royal University of Pavia (whose subsequent death has been announced), and Dr. Karl F. J. Sudhoff, professor of the history of medicine, University of Leipzig.

PROFESSOR H. C. GRAM, of Copenhagen, has been decorated by the French government as officier de l'instruction publique and by the Serbian Red Cross.

DR. GUSTAVE SCHELLENBERG, instructor of botany at the University of Göttingen, has been awarded the de Candolle prize of the Society of Physics and Natural History of Geneva.

DR. CLAUDIUS REGAUD, director of the Paris Radium Institute, has been awarded an honorary doctorate by the University of Brussels.

THE title of emeritus professor has been conferred by the University of Birmingham on Sir John Cadman, lately professor of mining in the university, who has resigned.

THE James Douglas gold medal, given annually in recognition of distinguished achievement in non-ferrous metallurgy, was conferred upon John Michael Callow, president of the General Engineering Co., of New York, at the annual meeting of the American Institute of Mining and Metallurgical Engineers, recently held in New York.

ARTHUR WILLIAMS, vice-president of the New York Edison Company, has been awarded the medal of the Legion of Honor for his work in behalf of the Home Appliance Exposition at Paris. Mr. Williams was previously decorated by the French government when he was made an officier de l'instruction publique.

SAMUEL A. TAYLOR, mining engineer of Wilkinsburg, Pa., has been elected president of the American Institute of Mining and Metallurgical Engineers.

SIR GILBERT WALKER, professor of meteorology at the Imperial College of Science and Technology at South Kensington, was elected president of the Royal Meteorological Society at its annual meeting on January 20.

PROFESSOR F. P. SLATER, formerly head of the physical laboratory in the experimental department of the Fine Cotton Spinners and Doublers Association, Ltd., and lately professor of textiles in the University of Manchester, has been appointed chief of the experimental department of the association in succession to Dr. W. Laurence Balls.

DR. JOHN BEATTIE, research assistant and demonstrator of anatomy at University College, London, has been appointed anatomist to the Zoological Society of London, with charge of the prosectorium at Regent's Park.

DR. GEORGE E. COGHILL, professor of anatomy at the University of Kansas, has been appointed to a newly created chair of comparative anatomy at the Wistar Institute, Philadelphia.

DR. WALTER C. ALVAREZ, associate professor of research medicine at the University of California Medical School, has accepted a position at the Mayo Clinic, Rochester, Minn.

DR. THOMAS T. READ, director of the safety service of the U. S. Bureau of Mines, has been chosen by the board of directors of the American Institute of Mining and Metallurgical Engineers to act as assistant secretary of the institute, with headquarters in New York.

BERNARD L. OSER, of the biochemical laboratory of the Philadelphia General Hospital, has joined the staff of the Food Research Laboratories, of New York City.

MAJOR E. A. GOLDMAN, of the Biological Survey, U. S. Department of Agriculture, left for Mexico in January to spend about two months making a study, in cooperation with the Mexican government, of conditions affecting migratory waterfowl on the principal wintering grounds in that country. The information secured will serve as a basis for concluding a migratory bird treaty with Mexico, if this is deemed desirable by both countries.

DR. CHARLES W. GILMORE, paleontologist of the Smithsonian Institution, who recently uncovered in the Grand Canyon of the Colorado River many footprints made by extinct animals, is preparing to return in a few weeks to the canyon and continue his investigations.

DR. ADOLPH HENRIQUES, assistant professor of radiology, Tulane University of Louisiana School of Medicine, New Orleans, has gone to France to study the treatment of high blood pressure by radiologic methods, and to observe developments in Europe in the roentgen-ray treatment of cancer.

RAY T. WEBBER, of the Gypsy Moth Laboratory, U. S. Bureau of Entomology, recently left for Europe, as agent for the Bureau of Entomology, in securing parasites for the gypsy moth and other introduced moths.

DR. WALTER BAADE, German astronomer, has arrived in the United States. He will spend one year here studying at various observatories.

DR. Y. TOKUDA, professor in charge of bee-culture at the Imperial Zootechnical Experimental Station at Chiba, Japan, is now in the United States studying apicultural conditions.

DR. KNUD FABER, professor of medicine at the University of Copenhagen, will deliver the sixth Harvey Society lecture at the New York Academy of Medicine on Saturday evening, March 13, at eight-thirty. His subject will be "Historical Lines of Therapy."

DR. FRANCIS G. BENEDICT, director of the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Mass., gave a lecture on "Food Needs in Health and Disease," before the Middletown Scientific Association, at Wesleyan University, on February 9.

DR. FRANCIS G. BLAKE, of Yale University School of Medicine, addressed the Connecticut Public Health Association at Bridgeport, on February 11, on "Scarlet Fever," and Dr. Haven Emerson, of Columbia University College of Physicians and Surgeons, New York, on "The Preventable Diseases of Adult Life."

DR. WM. C. ALDEN, of the U. S. Geological Survey, delivered an illustrated lecture, "The Mountains that Moved, or Through Glacier National Park with Saddle and Pack," at the Brooklyn Institute of Arts and Sciences on February 13. Dr. Alden will give the same lecture on March 15 at Teachers College, Columbia University.

AT a meeting of the Philosophical Society of Washington on February 20 Louis A. Bauer read a paper entitled "Are Sun Spots the Direct Cause of the Earth's Magnetic Storms?" and C. W. Kanolt read a paper on "The Work of the Cryogenic Laboratory of the Bureau of Mines."

THE faculty of the University of Michigan Medical School recently passed a memorial resolution expressing deep regret over the loss to American medicine in the death of Dr. Albion W. Hewlett, San Francisco. Dr. Hewlett was professor of medicine and director of the clinical laboratories at Michigan from 1908 to 1916.

A BUST of the late George Westinghouse, eminent American inventor, was recently completed by the well-known sculptor, Daniel Chester French. It was executed in behalf of the engineers of this country, represented by a committee consisting of Messrs. Ambrose Swasey, W. F. M. Goss, L. B. Stillwell, E. M. Herr and Calvin W. Rice. The Westinghouse bust is now on view at the headquarters of the American Society of Mechanical Engineers in New York, as this has been designated as its depository.

PRESTON PERKINS BAILEY, chemical engineer, formerly junior chemist in the U. S. Bureau of Mines, recently died.

DR. HENRY R. STEDMAN, well-known psychiatrist of Boston, died on February 20, aged seventy-seven years.

JOHN JACOB BAUSCH, founder and president of the Bausch and Lomb Optical Company, died on February 14, aged ninety-five years.

DR. WILLIAM EVANS HOYLE, who was the first director of the Welsh National Museum at Cardiff from 1909 until his retirement in 1924, died on February 7 at the age of seventy years.

RICHARD BULLEN NEWTON, formerly senior assistant in the geological department of the British Museum, died on January 23 in his seventy-second year.

R. A. F. MURRAY, a pioneer of the Geological Survey of Australia and government geologist from 1881 until 1897, has died, aged seventy-nine years.

DR. SIGMUND EXNER, the Austrian physiologist, died in Vienna on February 6, aged eighty years. He was for many years professor of natural sciences at the University of Vienna.

THE United States Civil Service Commission announces the extension to March 9 of the closing date for the receipt of applications for positions of organic chemist in the Bureau of Chemistry and physical chemist in the Bureau of Mines. The closing date originally announced was February 23. The entrance salary is $3,800 a year. After the probational period of six months required by the civil service act and rules, advancement in pay may be made without change in assignment up to $5,000 a year. The duties of the vacant position of organic chemist in the Bureau of Chemistry are to be responsible for and to direct the work of a laboratory engaged in the investigation and experimentation in connection with the utilization of raw materials grown or produced in the United States for coloring, medicinal and technical purposes.

THE Fourth National Colloid Symposium will be held at the Massachusetts Institute of Technology, on June 23, 24 and 25. Professor James W. McBain, Leverhulme professor of physical chemistry in the University of Bristol, England, is the guest-speaker. Inquiries about papers should be sent to Dr. H. B. Weiser, Rice Institute, Houston, Texas. Other inquiries, as well as notice of intention to attend the symposium, should be sent to Mr. Brian Mead, secretary of the local committee, Massachusetts Institute of Technology, Cambridge, Mass.

AT the two hundred and eighth meeting of the Northeastern section of the American Chemical Society, held at the Massachusetts Institute of Technology on February 12, Dr. G. J. Esselen, Jr., director of research and vice-president of Skinner, Sherman and Esselen, Inc., read a paper entitled "Rayon—Its Chemistry, Manufacture and Uses," and Professor Louis A. Olney, head of the department of chemistry of the Lowell (Mass.) Textile School, discussed "The Dyeing of Rayon." Each paper was illustrated by experiments and supplemented by an exhibit of rayon fibers, rayon fabrics and other "artificial silk" products.

THE University of Cincinnati has received charter of Sigma Xi fraternity, national honorary scientific organization, and local officers are: Professor Louis T. More, Dr. N. M. Fenneman and Professor Otto von Schlichten.

THE section on medical history of the College of Physicians, at Philadelphia, now meets bi-monthly. Its officers are as follows: *Chairman,* Dr. David Riesman; *clerk,* Dr. E. B. Krumbhaar; *executive committee,* Drs. C. W. Burr, F. P. Packard, T. MacCrae and H. R. M. Landis.

THE L. C. Smith College of Applied Science of Syracuse University observed its twenty-fifth anniversary by a student and alumni dinner at Hotel Syracuse on February 16. The speakers were Colonel Robert I. Rees, of the American Telephone and Telegraph Company; Calvin W. Rice, of the American Society of Mechanical Engineers, and Charles W. Flint, chancellor of Syracuse University.

THERE will be given at the Medical Society of London, under the auspices of the People's League of Health, a series of eight lectures on "The Mind and What we ought to know about it." The following is the syllabus: "Sensation, Perception, Ideation and Attention," Dr. R. H. Cole, February 1; "Mind and Body," Sir Frederick Mott, February 8; "Association of Ideas, Recognition and Memory," Dr. Thomas Beaton, February 15; "Habit, Adaptation," Sir Maurice Craig, February 22; "Crime and Delinquency," Dr. W. A. Potts, March 1; "Fatigue and Sleep," Dr. H. Crichton-Miller, March 8; "Primitive Instinct," Dr. E. D. Macnamara, March 15; "Mental Deficiency," Dr. A. F. Tredgold, March 22.

THE president of the Royal College of Surgeons, London, has announced that he has nominated Dr. F. G. Crookshank to deliver the Bradshaw lecture for 1926, and that the council has appointed Mr. W. F. Dearden to be Milroy lecturer for 1927. Professor W. W. Topley will deliver the Milroy lectures on "Experimental Epidemiology" on March 2, 4 and 9; Dr. Bernard Hart the Goulstonian lectures on "The Development of Psychopathology and its Place in Medicine" on March 11, 16 and 18, and Sir Thomas Horder the Lumleian lectures on March 23, 25 and 30.

AT the first organization meeting of the New York Society for Clinical Research, on February 5, Dr. Jacob Gutman was elected president, Dr. Alexander Kaye, secretary and Dr. Charles Herrman, treasurer; the purpose of the organization is to investigate the adaptability of the latest researches to clinical medicine.

THE University of Buffalo Physical Science Club has heard the following speakers since meetings commenced last fall: Dr. R. E. Riegel, "Absorption Spectra"; Professor L. G. Hector, "The Relation of Magnetic Measurements to Atomic Structure"; Dr. L. I. Dana, "The Electrical Theory of Solids"; Professor E. J. Moore, "Report of the Chicago Physical Society Meeting"; Dr. W. Stenstrom, "X-Rays"; Dr. B. O'Brian, "Certain Aspects of the Photoelectric Effect"; Professor Max Born, of the University of Göttingen, "Chemical Processes in the Light of Physics." The officers of the club are: Dr. L. I. Dana, *president;* Dr. B. O'Brian, *vice-president;* Mr. A. C. Jenkins, *secretary.*

A SERIES of six public lectures will be given during March by Dr. Ernst Antevs under the auspices of the Shaler Memorial Fund of the department of geology at Harvard University on Wednesday and Friday afternoons at 4:30. The general topic of the lectures will be "The Quaternary Ice Age." Individual titles are as follows: March 3, "Criteria and Causes of Glaciation." March 5, "Number and Nature of Quaternary Glaciations." March 10, "Waning of the Ice Sheets." March 12, "Life of the Quaternary Period." March 17, "Climates of Quaternary Time." March 19, "Changes of Level of Sea and Land Accompanying the Glaciations."

WE learn from *Nature* that the sixth International Ornithological Congress will be held at Copenhagen from May 24 to 29, under the presidency of Dr. E. Hartert, of the Zoological Museum, Tring. The work of the congress will be divided into five sections dealing, respectively, with: (1) Systematic ornithology, geographical distribution, paleontology; (2) anatomy, physiology, heredity and evolution; (3) biology, including ecology and bird migration; (4) oology, nidification; (5) bird protection and aviculture. The executive committee of the congress includes representatives of Denmark, France, Germany, Great Britain, Sweden and the United States. Communications for the congress should reach the honorary secretary, Mr. P. Bovien, care of Mr. E. Lehn Schiöler, Uraniavej, 14–16, Copenhagen, Denmark, not later than May 16.

ACCORDING to the *Journal* of the American Medical Association, the next tour of the Inter-State Post-Graduate Association of North America will start a few days after the Dallas meeting of the American Medical Association, and the party will reach Cherbourg, France, May 7; Rome, May 14; Florence, May 21; Venice, May 25; Munich, June 4; Prague, June 11; Berlin, June 15; Amsterdam, June 19; Brussels, June 24, and in the meantime visit other medical centers, sailing from Antwerp for home, June 26. The party goes abroad on invitation from the leading medical universities of the countries to be visited; it will

be limited to 500 members, including physicians' families and friends. Eminent clinicians and teachers in these foreign centers will have charge of the program of the assembly, covering every branch of medical science. For those who desire to stay longer, three return sailing dates have been arranged. Dr. William J. Mayo, Rochester, Minn., is president of clinics; Dr. Charles H. Mayo, general chairman of the foreign assemblies, and Dr. George W. Crile, Cleveland, chairman of the program committee.

THE Cambridge (England) University Medical Society will visit America during August and September, leaving Liverpool for Montreal, August 13. The party will comprise about 200 physicians and students of medicine at Cambridge University. They will go to Toronto, Niagara, Washington, Baltimore, Philadelphia, New York, New Haven and Boston.

DR. R. P. HIBBARD, president of the American Society of Plant Physiologists, writes that the society has established a life membership fund of $2,000, in honor of Dr. Charles Reid Barnes, who was, at the time of his death in 1910, professor of plant physiology at the University of Chicago. The fund has been established in accordance with plans accepted by the society at its second annual meeting at Kansas City. The interest of this fund will be used each year to elect to life membership in the society some member whose contributions to plant physiology make him most worthy to receive the honor. The members so elected will be known as the Charles Reid Barnes life members. The first election will be held in connection with the third annual meeting at Philadelphia, in December, 1926.

WILLIAM L. SAUNDERS, president of the United Engineering Societies, has given funds for the establishment and support of a gold medal to be conferred annually in recognition of achievement in the field of mining under the auspices of the American Institute of Mining and Metallurgical Engineers. A committee of well-known mining technologists will be appointed to formulate the terms of the award.

DR. FRANK SMITHIES has presented to the University of Illinois School of Medicine bonds in sufficient amount to yield annually, at a minimum and in perpetuity, the sum of $100, to be known as "The William Beaumont Memorial Fund," and the annual income therefrom, "The Annual Beaumont Memorial Award."

UNIVERSITY AND EDUCATIONAL NOTES

THE sum of $500,000 has been given to the University of Pennsylvania by Mr. and Mrs. Henry Phipps, of New York, to be devoted to the welfare of the Phipps Institute. The gift was made on condition that the university raise an equal amount for the institute.

AS a contribution toward the $500,000 which the University of New Brunswick now plans to raise as an endowment fund, Sir George E. Foster, an ex-finance minister of Canada, has contributed $50,000.

A GIFT of $500,000 to the Hebrew University of Palestine at Jerusalem has been made by Mrs. Sol Rosenbloom, of Pittsburgh.

THE endowment for the Henry Burchard Fine professorship of mathematics at Princeton University has been increased to $200,000 by a gift of $50,000 from Thomas D. Jones, trustee of the university. The gift makes the Fine chair the most heavily endowed in the Princeton faculty.

AMONG other bequests the late Dr. L. Emmett Holt has left the sum of $25,000 to Columbia University.

I. O. SCHAUB, director of the agricultural extension work at the Mississippi State College, has been appointed acting dean of the school of agriculture.

PROFESSOR ETHELWYNN R. BECKWITH, who was acting head of the department of mathematics at the College for Women at Western Reserve University last year, has been appointed head of the department of mathematics at Milwaukee-Downer College.

L. P. GABBARD, associate professor of agricultural economics at the University of Wisconsin, is resigning to take a position at the Texas Agricultural and Mechanical College.

DR. ADELE L. GRANT, instructor in botany at Cornell University, has resigned to accept a position as senior lecturer at Huguenot College, Wellington, South Africa.

PROFESSOR G. VIALE, of Sassari, Italy, has been appointed to fill the chair of physiology at the Rosario Medical School, Brazil.

DR. A. RADCLIFFE-BROWN, professor of social anthropology in the University of Capetown, South Africa, has been appointed to the new chair of anthropology at the University of Sidney.

DISCUSSION AND CORRESPONDENCE

MORBIDITY OF THE AMERICAN INDIANS

ON page xiv of *Science Supplement* in the issue of August 14, 1925, there appeared under the heading *Items* three paragraphs quoting a Dr. Hewett concerning morbidity and mortality among the American Indians and the character of the medical care provided for them by the Indian Bureau of the Department of

Agriculture, which is so full of error, which I can only believe is intentional, that I beg of you the courtesy to publish this reply. Unfortunately I did not read the item on the date of its appearance and have not until now had the facts in hand to refute the statements attributed to Dr. Hewett. Dr. Hewett is apparently not a physician, which may serve to excuse him for the errors of observation into which he has been led.

The pertinent facts concerning the health of the Indians are as follows:

Syphilis is not recorded as widespread among the Indians because the Indian Bureau does not provide physicians capable of diagnosing the disease, facilities for laboratory verification of diagnosis, or means for specific and appropriate treatment.

Fresh, primary and secondary syphilis was found abundantly in Taos Pueblo in 1923, introduced by young men returning to the Pueblos from industrial and lumber centers. No case was recorded by the local Indian Bureau contract doctor. The sores of syphilis were treated by this man with peroxide of hydrogen. At private expense treatment facilities were provided. Publicity drove the Indian Bureau to assume the cost of this clinical work, but in three months the bureau closed the clinic. Syphilis still goes undetected and untreated and hence unrecorded by the Indian Bureau.

At Zuni Pueblo, dysentery in a serious epidemic form with high mortality has now become endemic.

The very responsible National Committee for Prevention of Blindness passed the following resolution at its recent annual meeting on December 3, 1925, and was fully justified by the facts obtained by the surveys and clinical examinations of competent physicians not under Indian Bureau control.

Whereas, recent studies of health conditions among our 300,000 American Indian wards disclose an appalling prevalence of trachoma with its inevitable damage of vision and ultimate sequelae of blindness, and

Whereas, reports recently made public by governmental agencies charged with guardianship of these 300,000 Indian wards, confirmed also by many sincere friends of the American Indians, show that provisions are now made for a totally inadequate staff of highly trained persons to cope with the ravages of trachoma in the 30,000 cases reported by the Indian Agents, and

Whereas, the Secretary of the Interior and Commissioner of Indian Affairs are greatly handicapped in their sincere efforts in behalf of the health and welfare of these 30,000 afflicted Indians, both by shortage of skilled personnel and shortage of funds,

Therefore, Be It Resolved: That the National Committee for the Prevention of Blindness in annual meeting assembled, and representing upward of 14,500 persons who by annual contributions in memberships or by donations support every hopeful effort in lessening blindness, respectfully urge upon the Congress such increased financial support and additional legislation as may be required to more quickly alleviate the suffering and ravages of trachoma and minimize its incidence and to better cooperate with all social agencies in a position to help with this promising work so well begun by the Secretary of the Interior and his Commissioner of Indian Affairs.

And yet it is known that the Indian Bureau holds in trust with no benefit to the Indians $60,000,000 of their money.

Competent observers found trachoma to the extent of ten thousand cases among thirty-eight thousand Hopi Indians. Trachoma is more prevalent among the children of the compulsory boarding schools, where the children live under shockingly unhygienic conditions, than among the Indians of the Pueblos. Isolation or segregation of trachoma and tuberculosis is not attempted or provided for.

The Indian Bureau Medical Service has not been reorganized and is admittedly to-day the most disgraceful apology for scientific or humane medical care under the federal or state government.

At the boarding schools one finds children singing health poems to milk but receiving none, and reciting the dangers of coffee to childhood and getting it three times a day.

The Indian Bureau's published reports of Indian populations are full of inexcusable errors easily noted by reference to the following impossible statements.

For many years in succession, the Five Civilized Tribes of Oklahoma have been reported as numbering 101,506 persons, no change from year to year by births or deaths.

The Indians of California are supposed to have had the following fluctuations in their population:

1920	16,241
1921	12,725
1922	11,091
1923	13,335
1924	18,701

In reading these we can only agree with the little boy, that "somebody lied."

Outside of the transitory activity dealing with trachoma, which was pushed to conclusion in no one pueblo, and which did not reach the majority of pueblos at all, nothing whatever effective or adequate has been done by the government to meet either the disease conditions known through its own statistics or the disease conditions revealed through the investigations of private organizations.

Shut off from the help of county and state agencies,

practically shut off from the help of the U. S. Public Health Service, and confined within the Indian Bureau scheme of service, the Pueblo Indians are neglected just as the other tribal Indians are neglected. Their infant death-rate is extravagant, their eyesight is in jeopardy, and their racial tissue is being destroyed through venereal diseases.

HAVEN EMERSON,
President, American Indian Defense Ass'n
DIRECTOR OF INSTITUTE OF PUBLIC HEALTH,
COLUMBIA UNIVERSITY

THE BROWN'S PARK FORMATION

AMONG the paleontological material discovered during the summer of 1925 by Mr. J. LeRoy Kay of the section of paleontology, Carnegie Museum, is the remains of a long-jawed proboscidean most closely related to *Tetrabelodon osborni,* described by Professor Ervin H. Barbour.[1]

The above-mentioned specimen was discovered approximately six hundred to seven hundred feet above the base of the Brown's Park formation on the southern slope of Douglas Mountain, Moffatt County, Colorado. Mr. Kay has informed me both orally and by letter that this specimen referred to above is from the Brown's Park sediment; that there is no evidence that it was found in a later formation superimposed upon the Brown's Park; and that the find is from approximately the middle horizon of the vertical section of the Brown's Park strata in this locality.

Having these facts before us the question remains as to the age of the Brown's Park formation. In an earlier publication[2] this formation was cautiously referred to the lower and middle Miocene. From our recent discoveries this is no longer tenable. We must now regard the series as pertaining to the upper Miocene and lower Pliocene.

In the near future, when a complete study of the material obtained and more data on the geology of the region is at hand, a complete report will appear in the Carnegie Museum publications.

O. A. PETERSON
CARNEGIE MUSEUM

THE QUOTATION OF SCIENTIFIC REFERENCES

I HAVE been much interested in the correspondence concerning the methods of quoting references. In my work as lecturer on research in the Philadelphia College of Pharmacy and Science I have impressed upon my students the importance of giving both the year and volume, when such are available. Some German publications have no regular volume number, simply giving the "Jahrgang." I have advised that if there were a series number it should be placed in brackets as the first item, then should follow the year, the volume and the page. It is to be hoped, I think, that the practice of using Roman numerals for the volume will be entirely disregarded. In the smaller figures there is but little inconvenience, but in the higher numbers the system is very confusing. It has occurred to me that there might be an international agreement by which each journal in a certain department of science, say chemistry, should be given a number which might be in order of its seniority of its establishment—this would save the irregularity of abbreviations that are noticed in the literature and also ambiguity; for instance, "Ber." is now frequently used for the publications of the German Chemical Society, but there are other "Berichte."

Biblical critics, who possibly have a smaller number of journals for references, have adopted a simple method, at least for the more important: thus, BDMG is the sign of "Berichte der Deutschen Morgenländischen Gesellschaft"; PSBA, "Proceedings of the Society of Biblical Archeology." I think, however, the numbering system would be preferable.

I recall a case in which the reference was iv as the volume; the year was also given. I knew that volume four could not have been in that year but must be a much higher number. The real number was lv, the mention of the year saved me from a long search through the files. I see no particular objection to the use of a heavy faced type for the volume number and habitually employ it.

The subject is one of considerable importance, as the enormous extent of scientific literature obligates a writer to many references.

HENRY LEFFMANN
PHILADELPHIA, PA.

LITERATURE CITATIONS

I HAVE read with interest a number of letters which recently appeared in SCIENCE which dealt with the subject of simplified literature citations. All this is timely. References to volume number *ought* to be given in bold-face Arabic numerals instead of Roman numerals. But scientific writers are sometimes guilty of worse faults than giving references in cumbersome form; sometimes they exasperate their readers by omitting essential parts of their literature citations or even by leaving the references out altogether.

To take an almost random sampling from my reading of the last week or so: (1) Dr. A. has written a brilliant article on the validation of mental tests,

[1] *American Journal of Science,* Vol. XLI, No. 246, June, 1916, p. 522.

[2] Ann. Car. Mus., Vol. XV, 1924, p. 299.

but his references lose themselves in a mass of *"op. cit."* at the bottom of the page; (2) Dr. B. has written an excellent text on certain aspects of psychology, but he consistently omits the initials of the writers whose books he quotes, leaving one the annoying task of going through a whole drawer of "Smiths" at the library before finding the particular Smith whom Dr. B. had in mind; (3) Mr. C. conducts a very fine abstract department in his magazine, but his references to periodicals are by month and year without the volume, while the remainder of the magazine uniformly cites by volume and year without the month; (4) Dr. D. has written the best book yet on behaviorism, but the only references he gives are the surnames of the authors quoted inserted in the text in parentheses. Dr. D. remarks jauntily in his preface that the student who desires exact references "cannot be too early trained to use the Psychological Index."

There is something to be said for the *auto da fé*. It gave an exasperated public a chance to get even with scientific men who lacked a sense of responsibility.

PAUL HANLY FURFEY
THE CATHOLIC UNIVERSITY OF AMERICA

SCIENTIFIC BOOKS

Annals of Eugenics: a Journal for the Scientific Study of Racial Problems, Vol. I, Parts I and II, University Press, Cambridge, 1925, pp. 256.

THE Francis Galton Laboratory for National Eugenics has issued the first two parts of a periodical entitled the *Annals of Eugenics: a Journal for the Scientific Study of Racial Problems.* It is edited by the director of the Galton Laboratory, Professor Karl Pearson who, with Miss E. M. Elderton, contributes a foreword outlining the scope and aims of the new journal. Those who are familiar with the writings of Professor Pearson might be reasonably certain as to several things which would be said in this introductory statement. The journal is to be rigidly scientific, containing "the work of trained scientists rather than of propagandists and dilettanti." Emphasis is laid on the fact that the worker in the field of eugenics requires a fundamental training in mathematics as well as in genetics and anthropology. "By whatever manner we approach heredity and selection in man," the authors tell us, "we still meet the dominating fact that probability lies at the basis of our knowledge; and that snare-besprinkled area of mathematical science—where the greatest have been impaled—justifies us when we assert that the study of eugenics requires now, and will require still more as it advances in the future, the most highly trained scientific minds. Little real progress will be made by popular discussion, and by dilettante work."

There is a real need for a journal which publishes technical and mathematical papers on eugenics, a need which is scarcely met by such periodicals as *Biometrika* or *Metron.* The papers comprising the present issues of the *Annals of Eugenics,* for instance, do not quite fall within the scope of any other journal.

The first paper of the *Annals* is by Karl Pearson and Margaret Moul on "The Problem of Alien Immigration into Great Britain, Illustrated by an Examination of Russian and Polish Jewish Children." The English, like ourselves, have their immigration problems, and one of the most serious of these is occasioned by the influx of Russian and Polish Jews. The authors take the very reasonable position that "the law of patriotism for a crowded country surely must be to admit not those who merely reach our own average—and *a fortiori* not whose who fall below—but only those who can give us, either physically or mentally, what we do not possess or possess only in inadequate quantity." The endeavor is therefore made to find out whether the people of Jewish origin compare favorably with the average of the native British population. The data for the study of the Jewish population were obtained largely from school children, together with what information could be secured in regard to their parents. These findings were compared with those obtained from the Gentile school population living under various conditions. Nearly three fourths of the foreign-born Jewish parents were unable to make any really effective use of the English language, and about a third of the parents were illiterate even in their own language. The alien Jewish population has something like 50 per cent. more bad health than the corresponding native population. Notwithstanding the presumed immunity of the Jew to tuberculosis, the statistics seem to indicate a greater prevalence of tuberculosis among the Jewish children than among the average children of the London elementary schools. When it comes to bad tonsils and adenoids, heart disease, defective teeth, diseases of eyes and ears, and in fact most physical characters except stature and weight, the Jewish population is inferior to the average of the Gentiles. In cleanliness of clothes and person, the Jewish children are behind the average of the Gentiles, even of the poorer districts, and they have an unenviable record also for the toleration of pediculi. From the standpoint of physique, the available evidence does not indicate that the Russian and the Polish Jews are apt to raise the level of the British population.

Part II of the paper is devoted to an investigation of intelligence. The data were secured by teachers who graded their students into a number of classes ranging from very able to mentally defective. No

significant relationship was discovered between the occupation, education or health of parents and the intelligence of their children. There was also little correlation between the intelligence and the health, nutrition or cleanliness of the individual child. The intelligence of Jewish boys was somewhat better than that of the boys of the poorer Gentile schools, but inferior to that of the medium or superior Gentile schools. The Jewish girls were apparently less intelligent than the Gentile girls in all schools. One rather striking fact brought out by the investigation was that whereas, among the Gentiles, boys and girls of corresponding ages were of about the same degree of intelligence, among the Jews the girls were distinctly inferior in intelligence to the boys. How far this is a general racial characteristic is a question which requires further investigation.

There is no evidence in the memoir of any prejudice against the Jew. The authors state that their "chief fear in checking indiscriminate immigration is not that Britain may lose a supply of cheap labor, but that we may exclude a future Spinoza, a Mendelssohn, a Heine, or an Einstein. Yet in approaching the problem sympathetically and, as we hope, without bias, we can not see that unrestricted immigration has been an advantage to this country." What the verdict of the future will be no one can tell. A continuation of the memoir will appear in a subsequent issue.

Following a short illustrated article on hereditary epicanthus and ptosis, by C. H. Usher, there is an extensive, but unfinished memoir by Miss Ethel M. Elderton on "The Relative Value of the Factors which influence Infant Welfare." Miss Elderton has studied how infant mortality is affected by the age and health of parents, order of birth, cleanliness of the home, employment of the mother, occupation of the father, habits of the parents and food in the home. The influence of these various factors is expressed in terms of coefficients of correlation. Those interested in public health and sanitation will find much of interest in this memoir.

The last article is on the correlation of birthrates and deathrates with reference to Malthus's interpretation of their movements. The author, Mr. A. B. Hill, comes to the conclusion that "apart from the secular trend, there has been but slight connection in either country [England and Wales, and Sweden] between the deathrates and the birthrates closely following them, over the period of time for which the statistics are available."

A copy of a fine portrait of the Reverend T. R. Malthus forms a very appropriate frontispiece of the first number of the new *Annals*.

S. J. HOLMES

UNIVERSITY OF CALIFORNIA

SCIENTIFIC APPARATUS AND LABORATORY METHODS

NEW METHODS TO MEASURE THE RATE OF FLOW PRODUCED BY THE GILLS OF OYSTER AND OTHER MOLLUSCS

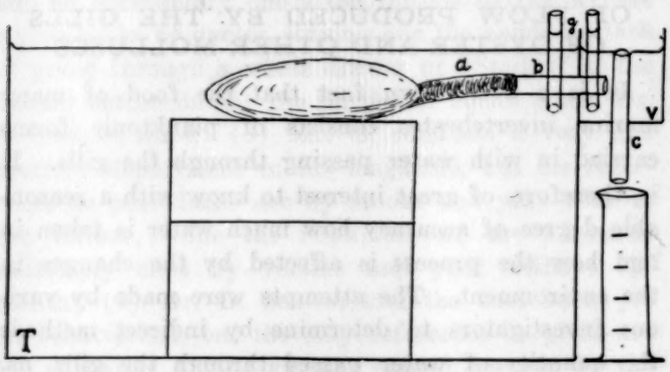
IT is a well-known fact that the food of many marine invertebrates consists of planktonic forms carried in with water passing through the gills. It is, therefore, of great interest to know with a reasonable degree of accuracy how much water is taken in and how the process is affected by the changes in the environment. The attempts were made by various investigators to determine by indirect methods the quantity of water passed through the gills, as, for example, determining the O_2 consumption and CO_2 formation, or by counting the number of plankton organisms in the stomach and in the outside water. So far as the oyster is concerned the figures vary from 300 to 8,000 cc per hour.

Better results can be obtained with the following two methods, which give the possibility to collect the water after it had passed the gills, and to measure the rate of flow and the pressure inside the gill cavity.

(1) The valves of the oyster are forced apart and a glass rod is placed between them to prevent their closing; a rubber tube (a), 6 to 7 mm in diameter, is inserted into the gill cavity and made fast by packing all the spaces around with cotton. The outgoing water passes through the tube; leakage, if any, can be easily noticed by adding a few drops of carmine suspension and watching the produced currents. The oyster is then placed into a tank (T) of about ten liter capacity; the tank is connected through a horizontal glass tube (b) of 6 mm diameter with a small vessel (V) about 50 cc capacity. A vertical tube (c) 8 mm in diameter goes through the bottom of a small vessel; its upper level is about 1 cm above the upper level of the horizontal tube b. The large tank is filled with water up to the level of the vertical tube c. When equilibrium is established the rubber tube a, inserted into the oyster, is connected to the horizontal tube b and the water from the gill cavity begins to flow into a small vessel; the overflowing water is collected in a graduate. To keep the levels constant fresh sea water is added into a large tank at the rate the water is propelled by the oyster.

The pressure inside the gill cavity can be measured by plugging the tube c and watching on the water gauges (g) the rise of the level in a small vessel. In a few minutes a maximum difference is reached and no more water flows through the tube b. This indicates that there is no more difference in pressure inside the gill cavity and at the end of the tube b.

The difference may be maintained as long as the gill epithelium keeps on beating. Under optimum conditions the highest difference observed was 4 mm.



(2) To measure the rate of flow the same oyster is placed into a tray; the end of the rubber tube (a) is attached to a ⊥ tube, the upper end of which is connected to a funnel filled with a fine carmine suspension and the third end is connected with a glass tube of same diameter; the tube is 17 cm long and is graduated into cms. Releasing the clamp a very small amount of carmine suspension is added; it forms a distinct cone moving inside the graduated tube. The rate of movement of the apex of the cone is then measured. Since a distinct cone of carmine suspension is visible it may be assumed that in this case we have "stream line" or viscous flow to which the Poiseuille's formula

$$\mu = \frac{\pi g d^4 p}{128 L q} \qquad (1)$$

is applicable.

In this formula μ = viscosity in poises, g = acceleration of gravity, d = diameter and L = length of capillary tube, q = rate of flow in cc per second, p = difference in pressure between two ends of the tube. The maximum velocity is at the center of the tube; the average velocity of flow throughout the whole sectional area is then one half the maximum velocity. If the viscosity of water and dimensions of tube are known the pressure p may be calculated.

The experiments performed this summer on oysters show that the rate of flow is a function of temperature. It reaches its maximum at 25° C. and slows down with the decrease of temperature. Below 7.6° C. no current is produced, though the cilia are still beating. At 5° C. they come to a standstill. There is a considerable individual fluctuation in the rate of flow depending on the physiological conditions of the organism. A healthy adult oyster, three to four inches long, at temperature about 25° C. may take in water at a rate of 3,000 cc per hour. This is a maximum figure frequently observed during the experiments.

By using the "tank" method the discharged water can be easily collected and analyzed. Counting the microplankton in the tank water and in the discharged water I found that more than 99.5 per cent. of diatoms and dinoflagellates are caught by the gills. Water after having passed the gills contains almost nothing but mucus.

Taking in of water depends not only on ciliary motion of the gill epithelium, but also on opening and closing of the shell. To study this phenomenon the oyster is immobilized and one valve is connected to a recording apparatus with daily clock movement. Observations made during August and September, 1925, on more than twenty oysters show that at temperatures from 15° to 22° C. the daily period when the shells remain open averages twenty hours.

PAUL S. GALTSOFF
U. S. BUREAU OF FISHERIES

SPECIAL ARTICLES

DISPLACED SERIES IN THE SPECTRUM OF CHROMIUM[1]

RECENT analyses of the complex spectra of the elements of the first and second long periods have classified hundreds of lines as combinations between numerous groups of terms. In only a few cases, however, have sequences or series of homologous terms been established, which are characterized by different values of the total quantum number. The explanation for this is to be found in the new theory of spectral terms which had its inception in recent work by Russell and Saunders[2] and was later developed into a practical theory by Hund.[3] These new ideas account for the low terms of a spectrum from the various possible ways of adding the azimuthal quantum numbers of the several valence electrons of the atom. The probability of the occurrence of corresponding terms with higher total quantum numbers is much less, with the consequence that the resulting spectrum lines are faint and inconspicuous.

In Fe a sequence of ^5D terms has been indicated by Gieseler and Grotrian,[4] and in Cr and Mo sequences of ^7S and ^5S terms have been used by Kiess[5] and by Catalan[6] for calculating series limits and ionization potentials. It is a striking fact that the

[1] Published by permission of the director of the Bureau of Standards.

[2] H. N. Russell and F. A. Saunders, *Astrophys. Journ.*, *61*, 38, 1925.

[3] F. Hund, *Zs. f. Phys.*, *33*, 345, 1925.

[4] H. Gieseler and W. Grotrian, *Zs. f. Phys.*, *25*, 165, 1924.

[5] C. C. Kiess and H. K. Kiess, SCIENCE, *56*, 666, 1922; C. C. Kiess, *Sci. Papers, Bur. Standards*, *19*, 113, 1923.

[6] M. A. Catalan, *Anal. Soc. Esp. Fis. Quim.*, *21*, 84, 1923.

few series-forming P and D terms of Cr and Mo are characterized by small term separations as compared with the much larger $\Delta\nu$'s separating the components of the many other terms which give rise to the ordinary multiplet groups found in Cr and other complex spectra. But small separations of arc terms can occur only when the generating spark term is single. The analysis of the spark spectrum of Cr, which is being made at the Bureau of Standards, has indicated the existence, among others, of a low and widely separated ^6D term and a somewhat higher ^5D term. But these could not be made responsible for the series-forming terms of Cr I.

Theoretically the following low terms may be expected in Cr II:[7]

three 3_3 and two 4_1 electrons: ^4F, ^4P, . . .
four 3_3 and one 4_1 electrons: ^6D, ^4D, ^4H, . . .
five 3_3 electrons: ^6S, ^4G, . . .

Since the two series-forming terms ^7S and ^5S of Cr I must be accounted for by the configuration of five 3_3 and one 4_1 electrons, the assumption seems justified that the higher terms of the series result from the configuration of five 3_3 and one 5_1 electrons; or, in other words, that they are built up on a ^6S term.

Since these terms of Cr I which are built up on the hypothetical ^6S term lie lower than those built up on ^6D, we concluded that ^6S would lie lower than the known ^6D term. A preliminary search through the known wave lengths of Cr II for a strong triplet showing the characteristic $\Delta\nu$'s, 141.0 and 92.2, of ^6P (known from the multiplet ^6D–^6P already published[8]) was without success.* We then estimated the position of ^6S as follows: Since $\infty\,^7S$ and $\infty\,^5S$ coincide with ^6S, we must find a series which converges to ^6D, that is, we must find a term ^5D (five 3_3, one 4_1, and one 5_1 electrons) which is the second member of the series beginning with the very prominent low ^5D term (five 3_3 and two 4_1 electrons). Such a term has been recognized from its position and $\Delta\nu$'s among the several unprimed ^5D terms, which the analysis of Cr I has yielded.[9] The following numerical values will suffice, calling the normal state of the atom zero:

$$4^7S_3 = 0$$
$$\infty\,^7S_3 = 56000$$
$$4^5D_4 = 8308$$
$$5^5D_4 = 48824$$

From Rydberg's table of the function $R/(m+a)^2$ we find that

$$4^5D_4 - \infty\,^5D_4 = 60420$$
whence $$4^7S_3 - \infty\,^5D_4 = 60420 + 8308 = 68730$$
and $$\infty\,^7S_3 - \infty\,^5D_4 = 68730 - 56000 = 12730$$

or, stated in words, the limits of the ^7S series and the ^5D series differ by 12730 cm^{-1} ($\pm$1000 cm^{-1}). This means that $^6S_3$ of Cr II lies 12730 ν units lower than ^6D. The group $^6D - {}^6P$ lies at wave length 2750A or $\nu = 36400$. The resonance triplet should, therefore, lie at $^6S - {}^6P = 49130$, or at approximate wave length 2035A.

The spectrum of the Cr spark was photographed by Mr. D. D. Laun, of this laboratory, with a large type E Hilger quartz spectrograph, the plate being an Eastman 33 coated with Nujol. An intense triplet was found in the region indicated. Measurement of the plate using as standards the Cu spark spectrum gave the following wave lengths:

λ. I A.	ν	$\Delta\nu$
2055.51 (8)	48634.08	
		141.29
2061.50 (7)	48492.79	
		92.26
2065.43 (6)	48400.53	

The $\Delta\nu$'s are identical, within the errors of measurement, with those resulting for ^6P from the multiplet $^6D - {}^6P$. Hence the normal state of Cr^+ is ^6S (five 3_3 electrons), thus necessitating a correction of an earlier tentative statement[10] that this state is represented by ^6D. The difference between $^6S_3$ and $^6D_5$ proves to be 12498 cm^{-1}.

It appears to be a general rule, which we have verified in several other spectra, that in all the relatively prominent series it is the s-electron that is excited and thrown to higher n_1 states. The s-electrons penetrate even into the K-shell without undergoing such irregular disturbances as may affect n_3 electrons and may cause anomalies similar to Wentzel's "broken series."[11] The fact that the Rydberg series formula is usually so well represented is evidently a consequence of this. As a further consequence we

[7] Compare Hund's paper, *l.c.*, esp. page 354.

[8] W. F. Meggers, C. C. Kiess and F. M. Walters, *J. O. S. A.*, and *R. S. I.*, *9*, 355, 1924; esp. page 368.

[9] We do not agree with the series arrangement for Cr, which was published by H. Gieseler, *Zs. f. Phys.*, *22*, 228, 1924. A second ^5D term, which is regarded as a higher series member, is apparently unreal.

* NOTE.—Since this paper was written we have found that approximate wave lengths for these lines have been measured by McLay; *Trans. Roy. Soc. Canada*, *17*, 137, 1923.

[10] Meggers, Kiess, Walters, *l.c.*

[11] G. Wentzel, *Zs. f. Phys.*, *19*, 53, 1923.